REMARKS

Claims 1-25 are pending in the application. Claims 24 and 25 are allowed. Claims 1-4, 6-17, and 19-23 stand rejected. Claims 5 and 18 stand objected to. Claims 1, 8, and 14 have been amended. Claims 26-31 have been added. Claims 1-31 remain in the application.

Claim 8 has been amended to correct grammar by adding the word "of".

The Examiner stated in response to the arguments of the earlier amendment:

> '1. Applicant's arguments filed 21 October 2003 have been fully considered but they are not persuasive.
>
> '2. First, the Examiner acknowledges and accepts the amendments made to the specification and drawings in the present amendment. There are no further objections to either the drawings or the specification.
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> '3. The Applicant begins formal arguments by reiterating the operation of Yamamoto et al. The Applicant contends that Yamamoto et al. is aimed at use in a digital copier, or printer that receives a digital record from a scanner such as a desktop scanner. The examiner does not disagree with the Applicant's contention, however; the Examiner takes the position that it makes no difference. The Applicant also contends that Yamamoto et al. describe the acquisition of the digital record using a single one-dimensional sensor array with a pattern of r, g, b filters sequentially arranged along the sensor. Again, the Examiner does not disagree with the Applicant's contention; however, the Examiner believes the Applicant does not give justice to the scope of Yamamoto et al. as a whole.
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> '4. In an attempt to overcome the Examiner's rejection of claims 1, 2, 4, 6-9, 12 –15, 17, and 19-22 under 35 U.S.C. § 103(b) as being anticipated by Yamamoto et al., the Applicant has amended independent claims 1 and 14. The Applicant's amendment to claims 1 and 14 further limit the original claims 1 and 14 by changing step (c) of those claims from "processing said at least one of the digital records with a

digital filter" to "processing said at least one of the digital records <u>in two dimensions</u> with a digital filter."

'5. The Examiner believes, with regard given to the Applicant's arguments, that the present amendment to claims 1 and 14 is the Applicant's attempt to claim that the digital records are comprised of two "dimensions", for instance a horizontal and a vertical "dimension"; rather than a single horizontal "dimension" as in Yamamoto et al. Regardless of what the Examiner believes the Applicant's intentions are, presently amended claims 1 and 14 do not limit the number of "dimensions" each digital record is comprised of, but rather limit the processing performed on each of the digital records. In the broadest reasonable interpretation of step (c) of presently amended claims 1 and 14, the processor performs processing on the digital records wherein the processing is performed in two "dimensions", or in other words the processing is performed in two steps, or in two stages, etc.

'6. To maintain the simplicity of this action, the Examiner traverses the Applicant with regard given to the Applicant's intentions (as stated above) rather than the broadest interpretation (also stated above). Yamamoto et al. teach of several different embodiments with focus primarily around a single one of those embodiments. The primary embodiment of Yamamoto et al. is comprised of the acquisition of a digital color record using a single row color image sensor wherein each color is arranged sequentially along the direction of the row. In the primary embodiment, Yamamoto et al. address color misregistration in a single "dimension" along the direction of the row.

'7. In addition, Yamamoto et al. provides several other embodiments in which color misregistration is addressed in two "dimensions." The Examiner directs the Applicant to column 16 (lines 7-45) of Yamamoto et al. In other embodiments, the color image sensor is not comprised of solely a single row, rather a plurality of single rows wherein each single row pertains to a particular color. In this embodiment, to completely acquire a digital color record, the image sensor is moved in a direction perpendicular to the direction of the row. Hence, a digital color record is acquired in two "dimensions": the first being along

the direction of the row and the second being along the direction perpendicular to the row. Therefore, not only do Yamamoto et al. address the color misregistration in a single "dimension" along the direction of the row, but in a second "dimension" along the direction perpendicular to the row.

'8. In another embodiment, Yamamoto et al. again uses a single row color image sensor wherein each color aperture along the direction of the row is of a different size. Therefore, in this embodiment, the first "dimension" is the direction along the row and the second "dimension" is the difference in aperture sizes in the direction along the row. Yamamoto et al. again address color misregistration in two "dimensions."

'9. As stated above, Yamamoto et al. disclose several embodiments in which the digital color records are in two "dimensions." In addition, the processor of Yamamoto et al. easily performs processing in two "dimensions" (stages, steps, etc.). Therefore, making amendments to claims 1 and 14 as the presented by the Applicant is simply not enough to overcome Yamamoto et al. The Examiner believes that the patentable aspect of the Applicant's invention lies within detecting a feature within the digital color records rather than the "dimensions" of the digital records. More specifically, detecting a feature using elements of the spatial frequency response method for a slanted edge feature according to the ISO 12233 standard is not taught or suggested in the prior art, as elaborated on below.'

The Response to Arguments has been reviewed and the language added by earlier amendment to Claims 1 and 14 has been revised.

Claims 1, 2, 4, 6-9, 12-15, 17, 19-22 stand rejected under 35 U.S.C. 102(b) as being anticipated by Yamamoto et al. The Examiner stated:

'For the following rejections, please refer to figures 1, 3, and 8 and columns 4 (lines 42-56), 5 (lines 14-68), 6 (lines 1-15 and 65-68), 7 (lines 1-20 and 47-68), 8 (lines 1-9), 9 (lines 38-68), 10 (lines 1-61), 11 (lines 21-68), 12 (lines 1-65), and 16 (lines 7-45). Yamamoto et al. disclose a method in color correction using a digital filter with a phase response that compensates for shifting and an amplitude response for

enhancing the sharpness. The Examiner notes that while Yamamoto et al. teach of the same method as the Applicant, the method of Yamamoto et al. is applied differently than that of the Applicant, however, the claims of the Applicant are written broad enough to be clearly read on the method of Yamamoto et al.'

In relation to Claim 1, the Examiner continued:

'For claim 1, Yamamoto et al. disclose a method of dot sequential error correction, correcting the color misregistration of the multicolor linear image sensor as shown in figure 3. The linear image sensor (104) is comprised of a linear array of photosensitive elements in which each photosensitive element is responsible for detecting a particular wavelength of light (either Red, Green, Blue or Cyan, Magenta, Yellow). Three photosensitive elements comprised of one set of primary colors/complementary colors (either Red, Green, Blue or Cyan, Magenta, Yellow) correspond to one dot (pixel), as shown in figure 3. Since, Yamamoto et al. teach of a completely digital system including shift registers (201 in figure 1), coefficient registers (202 in figure 1), and multipliers (205 in figure 1), it is inherent that all output from the image sensor (image reader in figure 1) is in digital (please also see figure 8). Therefore, Yamamoto et al. teach color registration correction, which is the correction of the error between color spacing differences in each pixel (approximately 1/3 of each pixel), since each color within the pixel is not in the same position, through the use of a digital filter in which the coefficients for amplitude and phase compensation are predetermined in the exemplary embodiment (figure 1) of through the feature/shift detection of each dot in the present embodiment (figure 8). The image feature detector (4) of figure 8 decides between two separate and different sets of coefficients for the compensation process. The first set of coefficients is determined based upon conventional linear interpolation methods, as stated in column 5, lines 14-45. The second set of coefficients is determined based upon the features of neighboring pixels and the shift/spacing differences between each color within a pixel, as stated in columns 5-10. The image feature detector resembles an edge detector since it decides upon which set of coefficients to use in compensation

based upon the features it detects in the present pixel from the neighboring pixels. For example, as stated in column 12 (lines 24-52), when the nearest neighboring pixels have large differences in lightness, hence the present pixel is an edge, the second set of coefficients (shift determination relative to the green color record) are used and when the nearest neighboring pixels are close in lightness, the first set of coefficients are used (similar to conventional linear interpolation). The colors within each pixel will herein be referred to as digital records wherein each digital record is wavelength-dependent (either Red, Green, Blue or Cyan, Magenta, Yellow).

'While the above paragraphs give a thorough explanation of primary embodiment Yamamoto et al., the Examiner understands that the Applicant has amended this claim to further specify the "dimensions" of the digital color records. Yamamoto et al. address color misregistration using a digital filter on a plurality of embodiments including the one in the paragraphs directly above and the other embodiments as fully explained in the Response to Arguments section of this action (please see above).

'Therefore, as stated above, there are three wavelength-dependent digital records per pixel.

'Yamamoto et al. disclose, a method for improving the wavelength dependent registration of digital images, said method comprising the steps of:

'a. Detecting a similar feature (in image feature detector 4) in two or more digital records (Red, Green, and Blue) of the same original search digital record (one pixel) being wavelength-dependent (The similar feature detected is the edge of the digital records with respect to each other within each pixel and surrounding pixels. Once the similar feature is detected, the image feature detector chooses the second set of coefficients to use for compensation.);

'b. Determining from the feature a shift due to misregistration of as least one of the digital records relative to another of the digital records (As stated above, the edge feature is detected for the digital records with respect to each other within each pixel and the neighboring pixels. When an edge is present, the second set of

coefficients is used, which are determined from the shifts in the digital records. As shown in figure 3, the digital records of a pixel are not in the same position as one another, therefore, their misregistration is a shift due to displacement); and

'c. Processing (performed in compensation circuit 2) said at least one of the digital records with a digital filter (compensation circuit 2, as shown in detail in figure 1) in two dimensions (as fully explained above) having a phase response that compensates for the shift, thereby providing a correction for the wavelength-dependent misregistration between the digital records (please see column 11, lines 43-46, and column 5, lines 61-68, and column 6, lines 1-15).'

In relation to Claim 14, the Examiner stated:

'For claim 14, also see claim 1 rejection, Yamamoto et al. disclose, a computer program product for improving the color registration of digital images comprising: a computer readable storage medium having a computer program stored thereon for performing the steps of (Although not explicitly taught, it is inherent that a computer readable storage medium having a computer program stored thereon, since Yamamoto et al. teach of an entirely digital system incapable of operation without microprocessor/CPU instruction driven control):

'a. Detecting a similar feature (in image feature detector 4) in two or more digital color records (Red, Green, and Blue) of the same scene (one pixel; The similar feature detected is the edge of the digital records with respect to each other within each pixel and surrounding pixels. Once the similar feature is detected, the image feature detector chooses the second set of coefficients to use for compensation.);

'b. Determining from the feature a shift due to misregistration of as least one of the digital color records relative to another of the digital color records (As stated above, the edge feature is detected for the digital records with respect to each other within each pixel and the neighboring pixels. When an edge is present, the second set of coefficients is used, which are determined from the shifts in the digital records. As shown in figure 3, the digital records of a pixel are not in the

same position as one another, therefore, their misregistration is a shift due to displacement); and

'c. Processing (performed in compensation circuit 2) said at least one of the digital color records with a digital filter (compensation circuit 2, as shown in detail in figure 1) in two dimensions (as fully explained above) having a phase response that compensates for the shift, thereby providing a correction for the color misregistration between the digital color records (please see column 11, lines 43-46, and column 5, lines 61-68, and column 6, lines 1-15).'

Amended Claims 1 and 14 state:

1. A method for improving the wavelength dependent registration of digital images, said method comprising the steps of:

(a) detecting a similar feature in two or more digital records of the same original search digital image being wavelength-dependent, said digital records each having two dimensions;

(b) determining from the feature a shift due to misregistration of at least one of the digital records relative to another of the digital records; and

(c) processing at least one of said digital records with a two-dimensional digital filter independently of the other said digital records, said digital filter having a phase response that compensates for the shift, thereby providing a correction for the wavelength-dependent misregistration between the digital records.

14. A computer program product for improving the color registration of digital images comprising: a computer readable storage medium having a computer program stored thereon for performing the steps of:

(a) detecting a similar feature in two or more digital color records of the same digital image of a scene, said digital records each having two dimensions;

(b) determining from the feature a shift due to misregistration of at least one of the digital color records relative to another of the digital color records; and

(c) processing at least one of said digital color records with a two-dimensional digital filter independently of the other said digital records, said digital filter having a phase response that compensates for the shift, thereby providing a correction for the color misregistration between the digital color records.

The language of amended Claims 1 and 14 is supported by the application as filed, notably, the original claims; page 8, line 28 to page 9, line 13; page 11, lines 10-17; and page 12, line 12 to page 13, line 2.

Claims 1 and 14 require that the digital records each have two dimensions and requires processing of at least one of the digital records with a two-dimensional digital filter independently of the other digital records. Yamamoto et al., in contrast, teaches against a linear interpolation method that processes independently of other records and then describes the invention of Yamamoto et al., a compensation processing technique that uses signals from three records:

> "In compensating the phase characteristics and resolution characteristics of a certain color signal component, the compensation processing, unlike the conventional technique employs the other color component signals as well. That is, for each of color component signals, the phase and resolution characteristic compensation processing is performed using a corresponding color and the other colors of a pixel of interest to be compensated and pixels near the pixel of interest." (Yamamoto et al., col. 5, line 46 to col. 6, line 1; see also col. 5, lines 14-45)

Claims 2, 4, 6-9, and 12-13 are allowable as depending from Claim 1 and as follows. Claims 15, 17, and 19-22 are allowable as depending from Claim 14 and as follows.

In relation to Claims 9 and 22 the Examiner stated:

> As for claims 9 and 22, Yamamoto et al. disclose, wherein step (c) comprises processing said at least one of the digital records with digital filter having a magnitude response that compensates for and aspect of the digital recorded other than mis-registration. It is inherent that the coefficients used for compensation from the digital filter with a magnitude (amplitude) response and a phase response. The phase response inherently

shifts the digital records while the magnitude response inherently brightens the digital records. Yamamoto et al. explicitly teach the design of the filter coefficients to compensate for phase and resolution errors (see column 5, lines 61-68, and 6, lines 1-15).

Amended Claims 9 and 22 state:

> 9 (original). A method as claimed in claim 1 wherein step (c) comprises processing said at least one of the digital records with digital filter having a magnitude response that compensates for an aspect of the digital records other than misregistration.
>
> 22 (original). A computer program product as claimed in claim 14 wherein step (c) comprises processing said at least one of the digital color records with digital filter having a magnitude response that compensates for an aspect of the digital color records other than misregistration.

The rejection of Claims 9 and 22 relies upon the use of signals from three records that occurs in the compensation processing technique of Yamamoto et al. The language of amended Claims 1 and 14 precludes that reliance, since the processing of step (c) is independent of the other digital records.

Claims 3 and 16 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto et al. in view of Herman et al. Claims 3 and 16 are allowable as depending from Claims 1 and 14, respectively.

Claims 10-11 and 23 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto et al. Claims 10-11 and 23 are allowable as depending from Claims 1 and 14, respectively, and on the grounds discussed above in relation to Claims 9 and 22.

Claims 5 and 18 stand objected to as being dependent upon a rejected base claim, but allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 5 and 18 are allowable as depending from Claims 1 and 14, respectively.

Added Claims 26-29 depend from Claim 1 and are allowable on that basis and as follows. Added Claims 26-29 as supported by the application as filed, notably, the original claims, Figure 2, and at page 10, lines 13-31.

Added Claim 26 states:

26. The method of Claim 1 wherein said processing further comprises convolving and said digital filter is a finite impulse response filter.

Claim 26 adds the limitation that the processing is convolving with a two-dimensional FIR filter.

Added Claims 27-28 state:

27. The method of Claim 1 wherein said determining further comprises estimating an edge location and edge direction of said feature.

28. The method of Claim 27 wherein said edge direction is slanted relative to said two dimensions of the respective said digital record.

Claim 28 requires that the estimated edge direction is slanted relative to the two dimensions of the respective digital record. The allowance of Claims 24-25 indicated that: "prior art does not teach or fairly suggest detecting similar features in wavelength-dependent digital records using elements of the spatial frequency response method for a slanted edge feature according to the ISO 12233 standard."

Claim 29 states:

29. The method of Claim 1 wherein said determining further comprises:

computing a first derivative of said feature using a derivative filter to define one or more lines;

computing a centroid of each of said lines; and

fitting a linear equation to each said centroid.

The language here is taken from the description of the spatial frequency response method for a slanted edge feature according to the ISO 12233 standard.

Claim 30 states:

30. A method for improving the wavelength dependent registration of digital images, said method comprising the steps of:

(a) detecting a similar feature in two or more digital records of the same original search digital image being wavelength-dependent, said digital records each having two dimensions;

(b) determining from the feature a shift due to misregistration of at least one of the digital records relative to another of the digital records; and

(c) processing at least one of said digital records with a two-dimensional digital filter, said digital filter having a phase response that compensates for the shift, thereby providing a correction for the wavelength-dependent misregistration between the digital records;

wherein said determining further comprises estimating an edge location and edge direction of said feature, said edge direction being slanted relative to said two dimensions of the respective said digital record.

Claim 30 is supported by the application as filed, notably, Claim 1, page 8, line 28 to page 9, line 13; page 11, lines 10-17; Figure 2, and at page 10, lines 13-31. Claim 30 is allowable on the grounds discussed above, particularly in relation to Claim 28.

Claim 31 states:

31. The method of Claim 1 wherein said processing further comprises convolving and said digital filter is a finite impulse response filter.

Claim 31 is allowable as depending from Claim 30 and is supported and further allowable on the same grounds as Claim 26.

It is believed that these changes now make the claims clear and definite and, if there are any problems with these changes, Applicants' attorney would appreciate a telephone call.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

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